

PURIFICATION AND STABILIZATION OF PEPTIDE AND PROTEIN PHARMACEUTICAL AGENTS

Abstract of the Disclosure

Methods are provided for purifying peptides and proteins by incorporating the peptide or protein into a diketopiperazine or competitive complexing agent to facilitate removal one or more impurities, i.e. undesirable components, from the peptide or protein. In a preferred embodiment, a peptide, such as insulin, containing one or more impurities, e.g., zinc ions, is entrapped in diketopiperazine to form a precipitate of peptide/diketopiperazine/impurity, which is then washed with a solvent for the impurity to be removed, which is a nonsolvent for the diketopiperazine and a nonsolvent for the peptide. Formulations and methods also are provided for the improved transport of active agents across biological membranes, resulting for example in a rapid increase in blood agent concentration. The formulations include microparticles formed of (i) the active agent, which may be charged or neutral, and (ii) a transport enhancer that masks the charge of the agent and/or that forms hydrogen bonds with the target biological membrane in order to facilitate transport. In a preferred embodiment, insulin is administered via the pulmonary delivery of microparticles comprising fumaryl diketopiperazine and insulin in its biologically active form. The charge on the insulin molecule is masked by hydrogen bonding it to the diketopiperazine, thereby enabling the insulin to pass through the target membrane. This method of delivering insulin results in a rapid increase in blood insulin concentration that is comparable to the increase resulting from intravenous delivery.